United States Environmental Protection Agency
Region 5
Air and Radiation Division
77 West Jackson Boulevard
Chicago, IL 60604

DATE: JUL 2 6 2011

SUBJECT: Inspection of Aventine Renewable Energy, Inc.
Pekin, Illinois

FROM: Dakota Prentice, Environmental Engineer
Air Enforcement and Compliance Assurance Section (IL/IN)

THRU: Brent Marable, Chief
Air Enforcement and Compliance Assurance Section (IL/IN)

TO: File

Facility:	Aventine Renewable Energy, Inc.
Location:	1300 South Second Street, Pekin, Illinois 61555
Inspection Date:	June 30, 2011
Inspection Team:	Molly DeSalle, Environmental Scientist, EPA Region 5 Dakota Prentice, Environmental Engineer, EPA Region 5
Facility Attendees:	Todd E. Benton, Director – Operations (Pekin), Aventine Steven B. Antonacci, Environmental Manager, Aventine Daryl Johnson, Environmental Specialist, Aventine

Purpose of the Inspection:

To investigate, inspect, and determine whether Aventine Renewable Energy, Inc. (Aventine) is in compliance with the Illinois State Implementation Plan (SIP) and the Federal Clean Air Act (CAA). This includes interviewing Aventine personnel and a facility tour.

Overview of Company:

Aventine operates a facility located in Pekin, Illinois (the facility) consisting of a corn wet mill and ethanol dry mill. The facility began operations in approximately 1890, when it was utilized for sugar beet processing. Production at the facility changed over time to corn wet milling (including ethanol production) and in 2007 a dry mill ethanol plant became operational. The facility is permitted to produce 110 million gallons per year (mmgy) of ethanol from the wet mill and 63.3 mmgy of ethanol from the dry mill. Both the wet and dry mills operate [redacted] (8x 4)

The main products from the wet mill are corn germ, corn gluten feed, corn gluten meal, grain distillers yeast, and denatured ethanol. The wet mill also sends carbon dioxide (CO_2) gas produced during fermentation to an adjacent CO_2 Plant owned by another company for processing and eventual resale. The main products from the dry mill facility are dried distillers grain (DDG) and denatured ethanol. Distillers wet grain (DWG) is produced in small quantities by the facility.

Opening Conference:

Molly DeSalle and Dakota Prentice (EPA Inspectors) arrived at Aventine at approximately 2:30 pm on June 30, 2011. EPA Inspectors were greeted by Steven Antonacci, the Environmental Manager of Aventine. After presenting credentials, EPA Inspectors were led to Mr. Antonacci's office at the facility's office building to explain the purpose of our visit.

The opening conference was attended by Aventine employees Todd Benton, Steven Antonacci, and Daryl Johnson. During the opening conference the EPA Inspectors stated this was an unannounced inspection and that questions would be asked about the facility's processes and a tour of the facility would be incorporated into the inspection. A review of the facility's processes was requested so the EPA Inspectors could understand the wet mill and dry mill processes.

Facility Operations:

Wet Mill

Aventine's wet mill process is located on those portions of the site that have been in operation since the late 1800's. The facility transitioned from sugar beet processing to corn products in approximately 1910, and began producing ethanol 1981.

The wet milling process separates the corn kernel into three main components to allow for the production of various products including gluten germ, gluten feed, and gluten meal. The Aventine wet mill also produces distillers yeast and ethanol.

The process begins when corn arrives at the facility by truck or rail from area farms located within approximately 75 miles of the facility. Approximately 90 percent of the corn arrives by truck, with the balance arriving by rail car. Each truck's corn delivery is probed for moisture content and general quality control parameters, to ensure the corn arriving at the facility is an adequate product.

Once the trucks are weighed at the scale house, they drive into a semi-enclosed building where they unload their grain onto the grated floor. This building is also utilized for either rail car unloading or loading DDG (from the dry mill) into trucks. At unloading, the grain falls through a mesh grate and onto a receiving belt below which directs the corn, via a conveyor, to one of the facility's storage silos. The receiving system uses negative pressure to pull the grain and particulate towards an underground receiving belt. The entire grain loadout process is controlled by one baghouse. The pressure drop readings for the grain receiving baghouse are recorded manually on a daily basis.

From the silos, the corn kernels are mechanically cleaned to remove debris and grain powder. Following cleaning, the corn is sent to steeping vessels in a batch process where they are mixed with a sulfurous acid solution. The facility has [redacted] and [redacted] Ex4 steeping tanks. The steeping process lasts approximately [redacted] while the tanks are maintained at approximately [redacted] Fahrenheit. Ex4 Steeping softens the kernel, breaks down the protein holding the starch particles, Ex4 and removes some soluble material.

The facility generates the sulfurous acid solution for the steeping process by burning sulfur onsite. The sulfur emissions are controlled by three wooden scrubbers, two primary and one backup. The acid solution is generated by the scrubber water, which is then sent to the steeping tanks. Although the corn does not travel between tanks, the steep water flows through the system from newest to oldest batch. Steep water leaving the final steeping tank is referred to as "light steep water." The light steep water is sent to evaporators to produce the [redacted] Ex4 syrup added to the fiber dryers.

Following completion of the steeping process, the steeped corn travels to degerminating mills. The first step is the grind mill, where the kernel is opened to remove the germ (without tearing the germ). The grind mill creates a heavy slurry which is pumped to "hydroclones" or liquid cyclones. The facility has [redacted] Ex4 liquid cyclones where the germ is extracted from the slurry. The germ is then transported to germ separation units where water is physically pressed out of the germ. The germ is then dried at [redacted]am tube rotary dryers prior to final shipment (via rail). Ex4 The dryers are controlled by cyclones. The germ is utilized for the production of corn oil by Aventine's customers. The facility produces approximately [redacted] Ex4. of germ per month.

Ex4

The heavy slurry now consists of approximately [redacted] gluten and fiber. This slurry is pumped through filter screens that remove the fiber and allow the starch and gluten to pass through. The fiber is water washed to remove any remaining starch, pressed to remove water, and dried in one of three steam tube rotary dryers. Syrup consisting of [redacted] Ex4 solids is added to the fiber in the dryers to produce corn gluten feed. The facility produces approximately [redacted] Ex4 of corn gluten feed per month. The fiber dryers are controlled by a condensing scrubber followed by a thermal oxidizer.

The slurry that passed through the filter screen, consisting of starch and gluten, is transported to Ex4 [redacted] centrifuges. From here the starch exits at the bottom of the centrifuge and gluten at the top. The gluten travels to five additional centrifuges to remove water. The gluten then travels to a rotary drum filtration unit and then to Ex4 [redacted] direct-fired dryers controlled by cyclones. The dried gluten is finally milled to produce a gluten powder for final shipment as corn gluten meal. The gluten dryers are controlled by cyclones

At this point in the process, the original heavy slurry has been reduced to a starch stream (slurry). This starch slurry is first washed and any remaining proteins are removed in clamshell shaped cyclones referred to as "cyclonettes."

The starch slurry then moves to the primary liquefaction tanks where ammonia and soda ash are added to increase the pH of the solution from 4 to approximately 5.6 to 5.7. Following pH adjustment, the enzyme alpha-amylase is added to begin breaking down the starches into dextrins. The starch slurry then travels to the hydroheater where the temperature is increased to [redacted] Ex4 Fahrenheit and held at that temperature for approximately [redacted] Ex4 in "hold coils." The slurry is then flashed down to [redacted] Ex4 Fahrenheit and pumped into the second liquefaction tanks. The total time spend in the liquefaction stage is approximately [redacted] Ex4

The slurry leaving the final liquefaction tanks then travels to the pre-saccharification tanks. The facility utilizes seven [redacted] Ex4 tanks for pre-saccharification. In this process, the slurry is diluted and the enzyme glucoamylase is added to break the dextrins down into simple sugars.

The slurry from the pre-saccharification tanks is then pumped to the fermentation tanks. Fermentation at the wet mill is a continuous process, utilizing a total of [redacted] Ex4 The continuous fermentation process takes approximately [redacted] Ex4, at which point the slurry enters the Beer Well Tank and consists of 12 percent ethanol. Emissions from the fermentation process are controlled by two CO_2 scrubbers. The CO_2 from the scrubbers it transported off site to a CO_2 plant operated by a separate company for eventual resale.

When the fermentation process is complete, the fermented mash including liquids and solids is transferred to the distillation system, through the beer well tank. The distillation system consists of a three columns (one beer stripper and two rectifier columns) where heat is added to drive a separation based on differences in boiling point. This series of columns produces an ethanol vapor product as well as a thin stillage product. The thin stillage generated from the wet milling process contains relatively minor amounts of solids. This thin stillage is either sent to evaporators and sold as a liquid feed for livestock or added to the corn gluten feed product.

The approximately 187-proof ethanol vapor leaving the distillation system is sent through a molecular sieve process consisting of four towers in a two bottle system. The sieve allows Aventine to remove the remaining water from the ethanol solution because of the difference in size of water and ethanol molecules. The entire process is completed in a closed loop system. The result is 200-proof ethanol which is sent to an evaporator to condense the vapor into liquid form. The liquid ethanol is then transferred to a 200-proof ethanol storage tank via a heat exchanger. Ultimately, the 200-proof ethanol will be mixed with a denaturant (gasoline) before it is sent to a final product storage tank.

The wet mill process also generates a distillers yeast product. A portion of the mash leaving the fermentation process is diverted to the yeast extraction building located on site. At the yeast extraction building the mash first goes through a centrifuge to remove non-yeast solids. The yeast slurry then moves to a distillation system to remove any remaining ethanol. Finally, the yeast slurry is passed through a spray dryer to create the final yeast product at [redacted] Ex4
Ex4 [redacted] moisture. Emissions from the yeast extraction process are controlled by a condensing scrubber and baghouse.

Aventine distributes the final ethanol product via truck, rail, or barge. The facility has one flare to control emissions from the truck loadout process. Loadout is automated to only begin once the flare's pilot light has been activated. The pump is automated to vent all emissions from the tank to the flare, before the pump is allowed to fill the tank with ethanol.

The wet mill utilizes two 242 million BTU per hour (mmBTU/hr) coal fired boilers and one 330 mmBTU/hr coal fired boiler. The facility also has one backup natural gas fired boiler rated at 195 mmBTU/hr.

Dry Mill

Aventine's dry mill is an ICM facility design built by Fagan Inc. The dry mill is completely separate from the wet mill with the exception of the grain receiving building, utilization of byproducts from the grain cleaning stage (i.e., grain screenings and powder) of the wet mill process, and final product liquid storage tanks.

The dry milling process grinds the entire kernel of corn into a flour/powder. The starch in the flour is converted to ethanol during a fermentation process, which creates carbon dioxide and distillers grain.

From the silos, the corn kernels are transferred to a "day bin" that is located between the two silos before the corn is sent to the hammer mill. The hammer mill is located just below the "day bin" and consists of three units. This is where the corn is ground into fine flour. The hammer mill has a baghouse as a control device, and the pressure drop readings are recorded manually on a daily basis. All logs are kept in the facility's main control room.

Once the flour is generated, it is sent to the "Slurry Tank #1," where the enzyme alpha-amylase is added, as is direct steam, ammonia, and process water. The enzyme is added to start breaking down the starches into dextrins. The slurry is then transferred to "Slurry Tank #2," where additional steam is added. Both units maintain the temperature of the slurry at approximately

Ex4

[redacted] Fahrenheit. The emissions from "Slurry Tank #1" are vented to "Slurry Tank #2," and all emissions from the second slurry tank are ultimately controlled by the facility's recuperative thermal oxidizer (RTO).

The slurry is then routed to the facility's hydroheater where it is heated to approximately [redacted] Ex4 [redacted] Fahrenheit with steam.

From the hydroheater, the slurry is sent through a series of two cook tubes. The slurry is held in the tubes at [redacted] Ex4 Fahrenheit. Then the slurry is sent to a flash tank, where the excess heat is flashed off and the mixture is cooled to [redacted] Fahrenheit. All the emissions from the flash tank are routed to the distillation process. Ex4

After the slurry has been cooled, it is sent to two liquefaction tanks in series, which are uncontrolled. The liquefaction process allows additional time for the starches to break down.

After liquefaction the slurry goes through a non-contact heat transfer unit with beer well slurry. This reduces energy use at the facility by raising the temperature of the beer well slurry without the use of steam.

Ex4

Once the liquefaction slurry reaches approximately [redacted] Fahrenheit, the liquid is split between transfer to one of the facility's four fermentation tanks or to propagation tanks. The propagation tanks are utilized to build up a specific yeast count needed for each fermentation batch run. When the yeast count has reached an optimal level, the contents of the entire propagation tank are added to a fermentation tank with the balance of the fermentation tank filled with slurry from the liquefaction tank.

As the slurry from the liquefaction tanks is pumped into a fermentation tank, glucoamylase enzyme is added to the slurry to break down the dextrins to form simple sugars. Yeast is then added to convert the simple sugars to ethanol and carbon dioxide gas (CO_2). Once inside the fermentation tanks, the slurry is referred to as mash. The fermentation process holds the mash for approximately [redacted] Ex4 for completion of the fermentation process. During this process a large amount of CO_2 is released. Each of the fermentation tanks is vented to the beer well tank, and the beer well directly vents to a scrubber to remove CO_2 from the air stream and recover water soluble volatile organic compounds. All liquid is directed from the fermentation tanks through the beer well tank before entering the distillation process, to ensure that the process can maintain a continuous flow. The facility also utilizes a purge scrubber to handle emissions from fermentation tanks between batches during cleaning.

When the fermentation process is complete, the fermented mash including liquids and solids is transferred to the distillation system, through the beer well tank. The distillation system consists of a three columns where heat is added to drive a separation based on differences in boiling point. The columns are referred to as the Beer Column, Rectifier, and Side Stripper. This series of columns produces an ethanol vapor product that is approximately 187 proof as well as a wet stillage product consisting of undigested mash.

The 187-proof ethanol vapor is sent through a series of three towers that are part of the molecular sieve process. The entire process is completed in a closed loop system. The result is 200-proof ethanol which is sent to an evaporator to condense the vapor into liquid form. The liquid ethanol is then transferred to a 200-proof ethanol storage tank via a heat exchanger. Ultimately, the 200-proof ethanol will be mixed with a denaturant (gasoline) before it is sent to the final product storage tank. All emissions generated during the molecular sieve process are vented to the facility's RTO.

The facility has two final product storage tanks which each have a capacity for [redacted] Ex 4 gallons of denatured ethanol. The final product storage tanks are utilized by both the wet and dry mills. The dry mill utilizes the same storage tanks as the wet mill with the exception of one 165,000 gallon tank used only by the dry mill for 190-proof ethanol.

The stillage from the bottom of the distillation process (whole stillage) contain a percentage of solids from the grain and yeast, as well as liquid from any water added during the process. This stillage is sent to the centrifuges to remove water and collect the remaining solids. The centrifuges produce a thin stillage (liquid with a percentage of solids) and WDG.

The thin stillage is routed either back to the slurry tanks to be used as process water or to either Evaporator #1 or multi-effect evaporators (Evaporator #2 through #8) at the facility. Evaporator #1 transfers heat from the ethanol vapor leaving the molecular sieve process to the thin stillage. Evaporators #2 through #8 heat the thin stillage with steam produced from the boilers at the facility. The syrup contains approximately [redacted] solids. Emissions from the evaporators are routed to the RTO. Ex 4

The WDG from the centrifuges is sent to the first of two dryers in series at the facility. The facility has two natural gas fired dryers. The dryers' emissions are routed to the RTO at the facility. Syrup from the evaporators is mixed in with the WDG at the dryers.

Upon exiting one of the second gas-fired dryer, the DDG product is transported to a storage warehouse for final cooling prior to shipment. The DDG is placed in piles to allow for the moisture of the material to equilibrate prior to shipment. When the DDG is ready for shipment it is pushed to an underground conveyer that delivers the DDG to the truck loadout area for shipment. Emissions from the DDG loadout process are controlled by a dedicated baghouse.

Aventine's main product from the dry mill is denatured ethanol, but it also sells DDG as a by-product and the DDG is exported from the facility by either truck (predominantly) or rail.

Aventine distributes the final ethanol product via truck, rail, or barge. The facility has one flare to control emissions from the truck loadout process. Loadout is automated to only begin once the flare's pilot light has been activated. The pump is automated to vent all emissions from the tank to the flare, before the pump is allowed to fill the tank with ethanol.

Facility Tour:

After the overview of Aventine's processes, we requested a tour of the facility. The tour began at 4:00pm.

Todd Benton, Steven Antonacci, and Daryl Johnson represented Aventine throughout the tour.

The tour began at the wet mill. EPA Inspectors were shown the major processes associated with the production of corn germ, corn gluten feed, corn gluten meal, and distillers yeast. EPA Inspectors were also shown the boilers. All three coal-fired boilers were in operation at the time of the inspection.

Next the EPA Inspectors viewed the dry mill. The EPA Inspectors walked through the fermentation process and were able to view the slurry tanks, hydroheater, liquefaction tanks and fermentation tanks, before walking outside the main process building to view the CO_2 scrubber.

After viewing the distillation process and molecular sieve units, the EPA walked to the building housing the dryers. The two RTOs and feed cooling drum were located at the exterior of this building. The EPA inspectors were shown the control room where operating parameters and continuous emissions monitoring system (CEMS) data is recorded.

EPA Inspectors passed by the DWG and DDG storage locations. The DWG storage area allows the facility to produce DWG if the RTO or dryers are down. The DDG warehouse utilizes an underground conveyer to deliver the DDG to the truck load out location for final shipment.

After our return to the conference room, we requested some time to gather our notes before a final closing conference.

Closing Conference:

The closing conference was conducted at approximately 5:00 pm. Aventine requested that information provided during the inspection associated with timing, temperatures, and production rates be treated as confidential business information. Aventine was informed that a CAA Section 114 Information Request would be sent to the facility. The EPA inspectors concluded by stating that an inspection report would be prepared and the report may be available via the Freedom of Information Act if a copy of the report was desired.

Records Obtained:

1. Production Yield Report – 2010/2011
2. Aventine Production Flow Chart - Labeled as "Corn to Ethanol Conversion Process"